

IN THE DRAWINGS:

Please amend Figures 1-8 and 38-40 by replacing the existing drawing sheets containing existing Figures 1-8 and 38-40 with the replacement drawing sheets (each designated as a "Replacement Sheet") containing amended Figures 1-8 and 38-40 as indicated attached Appendix A.

REMARKS

The Office Action dated June 22, 2010, has been received and carefully considered. In this response, Figures 1-8 and 38-40 and claims 1, 3, 5, 8, 11, 31, 35, 40, 42, 44, 45, 47-56, 58, 60, 63, 66, 86, 90, 95, 97, 100-102, 104-113, 115, 147, 152, 166, 168, 170, 202, 207, 209, 225, 227, 259, 264, 280, 282, 314, 319, 321, 449, and 450 have been amended. No new matter has been added. Entry of the amendments to Figures 1-8 and 38-40 and claims 1, 3, 5, 8, 11, 31, 35, 40, 42, 44, 45, 47-56, 58, 60, 63, 66, 86, 90, 95, 97, 100-102, 104-113, 115, 147, 152, 166, 168, 170, 202, 207, 209, 225, 227, 259, 264, 280, 282, 314, 319, 321, 449, and 450 is respectfully requested. Reconsideration of the pending objections/rejections in the present application is also respectfully requested based on the following remarks.¹

I. THE EXAMINER INTERVIEW

At the outset, the undersigned thanks the Examiner for the courtesies extended during the interview conducted on September

¹ As Applicants' remarks with respect to the Examiner's rejections are sufficient to overcome these rejections, Applicants' silence as to assertions made by the Examiner in the Office Action or certain requirements that may be applicable to such rejections (e.g., assertions regarding dependent claims, whether a reference constitutes prior art, whether references are legally combinable for obviousness purposes) is not a concession by Applicants that such assertions are accurate or such requirements have been met, and Applicants reserve the right to analyze and dispute such in the future.

8, 2010, during which agreement was reached on amending the independent claims to recite a direct coupling between processing means and single-level direct subband transformers and a direct coupling between processing means and single-level inverse direct subband transformers, which is reflected herein.

II. THE ALLOWABILITY OF CLAIMS 14-30, 35-39, 42-55, 69-85, 90-94, 97-112, 126-142, 147-151, 154-167, 181-197, 202-206, 209-224, 238-254, 259-263, 266-279, 293-309, 314-318, AND 321-336

Applicant notes with appreciation the indication on page 20 of the Office Action that claims 14-30, 35-39, 42-55, 69-85, 90-94, 97-112, 126-142, 147-151, 154-167, 181-197, 202-206, 209-224, 238-254, 259-263, 266-279, 293-309, 314-318, and 321-336 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. However, Applicant has opted to defer rewriting the above-identified claims in independent form pending consideration of the arguments presented below with respect to the rejected claims.

III. THE OBJECTION TO THE DRAWINGS

On page 2 of the Office Action, the drawings were objected to under 37 CFR § 1.121(d) as failing to designate as "Prior Art."

Applicants have amended the drawings to address the Examiner's concerns. Entry of the replacement drawing sheets is hereby respectfully requested.

In view of the foregoing, Applicant respectfully requests that the aforementioned objection to the drawings be withdrawn.

IV. THE NON-STATUTORY SUBJECT MATTER REJECTION OF CLAIMS 449 AND 450

On pages 3-4 of the Office Action, claims 449 and 450 were rejected under 35 U.S.C. § 101 as being directed to non-statutory subject matter. This rejection is hereby respectfully traversed.

The Examiner asserts that the limitation "storage medium" in claims 449 and 450 may be interpreted as a non-statutory intangible embodiment. See Office Action, pages 3-4. Claims 449 and 450, as amended, each recite "at least one non-transitory processor readable storage medium for storing a computer program of instructions." Applicants respectfully submit that amended claims 449 and 450 recite functional descriptive material (i.e., computer instructions) stored on at least one non-transitory processor readable storage medium. Therefore, the functional descriptive material becomes structurally and functionally interrelated to the at least one non-transitory processor readable storage medium and is thus

directed to statutory subject matter. Applicants also respectfully submit that claims 449 and 450 satisfy the requirement set forth in the Interim Guidelines. The instructions are stored on the at least one non-transitory processor readable storage medium and are therefore statutory as set forth by the Interim Guidelines. Thus, claims 449 and 450 satisfy the Interim Guidelines and the statutory matter requirement under 35 U.S.C. § 101.

Furthermore, claims 449 and 450 recite a "at least one non-transitory processor readable storage medium." A person of ordinary skill in the art when reading claims 449 and 450 would not interpret at least one non-transitory processor readable storage medium as a signal or software per se. Indeed, interpreting at least one non-transitory processor readable storage medium as a signal or software per se would not be a reasonable interpretation. Although the PTO must give claims their broadest reasonable interpretation, this interpretation must be consistent with the one that those skilled in the art would reach. See In re Morris, 127 F.3d 1048, 1054, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997) ("[T]he PTO applies to the verbiage of the proposed claims the broadest reasonable meaning of the words in their ordinary usage as they would be understood by one of ordinary skill in the art.").

In view of the foregoing, Applicant respectfully requests that the aforementioned non-statutory subject matter rejection of claims 449 and 450 be withdrawn.

V. THE OBVIOUSNESS REJECTION OF CLAIMS 1, 3-13, 31-34, 56, 58-68, 86-89, 113, 115-125, 143-146, 168, 170-180, 198-201, 225, 227-237, 255-258, 280, 282-292, 310-313, 449, AND 450

On pages 4-17 of the Office Action, claims 1, 3-13, 31-34, 56, 58-68, 86-89, 113, 115-125, 143-146, 168, 170-180, 198-201, 225, 227-237, 255-258, 280, 282-292, 310-313, 449, and 450 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,141,446 to Boliek et al. ("Boliek") in view of U.S. Patent Hang No. 5,038,209 to Hang ("Hang"). This rejection is hereby respectfully traversed with amendment.

Under 35 U.S.C. § 103, the Patent Office bears the burden of establishing a prima facie case of obviousness. In re Fine, 837 F.2d 1071, 1074 (Fed. Cir. 1988). There are four separate factual inquiries to consider in making an obviousness determination: (1) the scope and content of the prior art; (2) the level of ordinary skill in the field of the invention; (3) the differences between the claimed invention and the prior art; and (4) the existence of any objective evidence, or "secondary considerations," of non-obviousness. Graham v. John Deere Co., 383 U.S. 1, 17-18 (1966); see also KSR Int'l Co. v. Teleflex Inc., 127 S. Ct. 1727 (2007). An "expansive and flexible

approach" should be applied when determining obviousness based on a combination of prior art references. KSR, 127 S. Ct. at 1739. However, a claimed invention combining multiple known elements is not rendered obvious simply because each element was known independently in the prior art. Id. at 1741. Rather, there must still be some "reason that would have prompted" a person of ordinary skill in the art to combine the elements in the specific way that he or she did. Id.; In re Icon Health & Fitness, Inc., 496 F.3d 1374, 1380 (Fed. Cir. 2007). Also, modification of a prior art reference may be obvious only if there exists a reason that would have prompted a person of ordinary skill to make the change. KSR, 127 S. Ct. at 1740-41.

Regarding claim 1, the Examiner asserts that the claimed invention would have been obvious in view of Boliek and Hang. Applicants respectfully disagree. However, in order to forward the present application toward allowance, Applicants have amended claim 1 as discussed during the Examiner Interview conducted on September 8, 2010, to more specifically define the claimed invention, and specifically those features that further differentiate the claimed invention from Boliek and Hang, as well as the other cited references. In particular, Applicants respectfully submit that Boliek and Hang, either alone or in combination, fails to disclose, or even suggest, a fast encoder for compressing input data into output compressed data

comprising: a plurality of single-level direct subband transformers, the plurality of single-level direct subband transformers for receiving and transforming input data to produce transformation coefficients; a plurality of processing means, each of the plurality of processing means directly coupled to at least a respective one of the plurality of single-level direct subband transformers, each of the plurality of processing means selected from a group consisting of: pass-through means for lossless processing and quantizer means for lossy processing, for directly receiving and processing respective transformation coefficients to produce processed transformation coefficients; a plurality of encoding probability estimators, each of the plurality of encoding probability estimators coupled to at least a respective one of the plurality of processing means, for receiving respective processed transformation coefficients and estimating probabilities of symbols within contexts of transformation coefficients to produce the probabilities of symbols within the contexts of transformation coefficients; a plurality of entropy encoders, each of the plurality of entropy encoders coupled to at least a respective one of the plurality of encoding probability estimators, for receiving and entropy encoding respective processed transformation coefficients using respective probabilities of symbols within respective contexts of

transformation coefficients to produce encoded data; and an output compressed buffer coupled to the plurality of entropy encoders, for receiving and substantially synchronizing the encoded data from each of the plurality of entropy encoders to produce output compressed data, as presently claimed.

Applicants first note that the Examiner apparently did not realize that one of the main goals of the claimed invention is the minimization of buffering memory size, while the combination of Boliek and Hang actually increases buffering memory complexity and size as anyone with skill in the art would understand. For example, Figure 2 of Boliek depicts additional elements, which are not present in Hang, such as multi-component handling 211, style select 210, and embedded binary style coding 204. These elements are not present in claim 1, so they will be neglected from the following analysis.

Next, Applicants would like to draw the attention of the Examiner that the video encoder of Hang utilizes buffer/quantizer controller 110 to regulate the degree of buffer fullness, while the present invention utilizes an ordinary output compressed buffer without such a controller.

Figure 2 of the present application discloses a prior art image encoder with an output compressed image buffer 18, as described on page 11, lines 23 to 29:

"FIG. 2 is a block diagram of the state-of-the-art encoder 30. The input uncompressed image 10 is received by the direct subband transformer 20. The output of the direct subband transformer 20 are transformation coefficients 12, which can be quantized into the quantized transformation coefficients 14 in the quantizer 24, in case of lossy compression, or just passed to the encoding probability estimator 26, in case of lossless compression. The outputs of the encoding probability estimator 26 are symbol probabilities 16 within the specified contexts, which are used by the entropy encoder 28, in order to produce the output compressed image 18."

All prior art encoders have an output compressed image buffer similar to 18, including Boliek for image and Hang for video (column 2, line 67 to column 3, line 1):

"Output bit stream 107, which is comprised of the compressed coefficients supplied by entropy encoder 106, is stored in output buffer 108."

However, Hang also utilizes a buffer after the quantizer according to claim 1, column 6, line 60 to 62, and claim 12, column 8, line 15 to 16:

"... buffer means for storing a quantized version of said digital signal representing said video signal ...".

Furthermore, Hang utilizes additional buffers in inter/intra

transform coefficients generator 102, in order to generate interframe differences and receive fed back quantized coefficients 105 in column 3, lines 13 to 18:

"In order to generate the interframe differences, in either the spatial domain or in the frequency domain, quantized coefficients 105 are fed back to inter/intra transform coefficients generator 102. The operations of quantizer 104, entropy coder 106, and output buffer 108 are synchronized in time and are well-known."

Applicants would like to draw the Examiner's attention to well-known prior art synchronization operations of quantizer, entropy encoder, and output buffer, as shown in Figures 5 and 7 of the present application. Applicants also strongly disagree with the Examiner that Hang teaches synchronization without any corresponding descriptive embodiment.

Boliek does not explicitly disclose a data buffer to synchronize data, but is completely aware about associated delays, as discussed at column 30, line 31:

"In fact, there is a maximum delay between encoding and the production of a compressed output bit."

Besides this delay, Boliek requires huge memory for storage of all transformation coefficients, as do all prior art encoders

exemplified in Figures 5 and 7, due to:

1) storage of uncompressed transformation coefficients in the memory, disclosed in Boliek column 17, line 38 to 41 ("Since the decomposed images are physically smaller than the original image due to subsampling, the same memory used to store the original image can be used to store all of the decomposed subbands.");

2) parent-child context dependent relationship, disclosed in Boliek Figure 1 and Boliek column 17, line 55 to column 18, line 7, which requires that ALL transformation coefficients from all wavelet decomposition levels MUST BE available at the same time in the memory BEFORE generating contexts, because relationships between transformation coefficients from all wavelet decomposition levels must be generated starting from the first to the last decomposition level (usually 3 to 7 levels, depending on image resolution);

3) the utilization of "bit-planes" as importance level planes of the transformation coefficients and context model conditions wavelet coefficients in bit-significance representations, as disclosed in Boliek Figures 39 and 40, column 10, lines 19-23 and column 20, line 63 to column 21, line 5, which requires that ALL transformation coefficients MUST BE available at the same time in the memory BEFORE generating bit-plane contexts, because ALL bits at the same binary position

(selected between most significant bit and least significant bit) from ALL transformation coefficients must be extracted in order to generate a bit-plane for that binary position, thus providing 24 separate bit planes for 24-bit long transformation coefficients, for example; and

4) entropy encoding after the histogram is generated, since "based on the histogram, the style is chosen", as disclosed in Boliek column 12, lines 2-8, which means that ALL transformation coefficients MUST BE available at the same time in the memory BEFORE start of the encoding, because histograms of transformation coefficients must be calculated first, then a style must be chosen and finally entropy encoding of the same transformation coefficients will be performed.

It is obvious from the aforementioned facts that reversible wavelet transform, embedded order quantization, context modeling, and entropy coding in Boliek require huge synchronization memory producing delay, which is also confirmed by related U.S. Patent Nos. 5,966,465 (claims 1, 15, 16, 28, 33, 38, 39, 40 and 43), 5,867,602 (claims 31, 36 and 40) and 5,748,786 (claims 1, 9 and 17), which all resulted from a continuation-in-part process started from the same basic patent application U.S. Patent Application No. 08/310,146. More specifically, Boliek (U.S. Patent No. 6,141,446) is a continuation-in-part of U.S. Patent Application No. 08/643,268,

entitled "Compression/Decompression Using Reversible Embedded Wavelets", filed May 3, 1996, now U.S. Pat. No. 5,966,465, which is a continuation-in-part of U.S. Patent Application No. 08/498,036, entitled "Reversible Wavelet Transform and Embedded Codestream Manipulation", filed June 30, 1995, now U.S. Pat. No. 5,867,602, which is a continuation-in-part of U.S. Patent Application No. 08/310,146, entitled "Apparatus for Compression Using Reversible Embedded Wavelets", filed September 1, 1994, now U.S. Pat. No. 5,748,786.

Therefore, the combination of Boliek buffers and Hang buffers would not reduce the total size of required buffers, but on the contrary increase it.

In contrast, the present invention as set forth in claim 1 is directed to a new lossless and lossy encoder, as shown in Figures 13 and 15 of the present application, by utilizing either state-of-the-art or new elements, such as: a single-level direct subband transformer, processing means, an encoding probability estimator, an entropy encoder and an output compressed buffer, connected AFTER the entropy encoder, without any additional buffer in an inter/intra transform coefficients generator for generating interframe differences and receiving fed back quantized coefficients used in Hang description, and any additional buffer for storing a quantized version of a digital signal as used in Hang (see, e.g., claims 1 and 12).

Comparing claim 1, as shown in Figures 13 and 15 of the present application, to the combination of Boliek and Hang, clearly demonstrates that the present invention discloses synchronizing already encoded (compressed) data in the output compressed buffer, thus requiring very little synchronization memory, while Boliek and Hang buffer (uncompressed) transformation coefficients, thus requiring huge memory. Furthermore, the combination of Boliek and Hang must always use quantized coefficients and perform lossy processing only, which is a distinction that was lost on the Examiner.

Therefore, any combination of Boliek and Hang, as would be understood by anyone with ordinary skill in the art, will provide a resulting encoder in the form of prior art encoders as shown in Figures 5 and 7 of the present application with additional buffers, and not in the form of new encoders disclosed in Figures 9, 11, 13 and 15 of the present application, which decrease total memory capacity for several orders of magnitude in comparison with prior art encoders, due to storage of compressed data instead of uncompressed transformation coefficients in memory, and as a positive side-effect significantly increase encoding speed, as disclosed on pages 48-50 of the present application.

In summary, Applicants respectfully submit that the Examiner's assertion "that one of ordinary skill in the art

would have been motivated to modify and include the codec system Boliek made with the application of synchronization buffer as taught by Hang, because this is one well-know way to regulate the data flow as discussed by Hang" is completely wrong, because the present invention does not utilize the regulation of the data flow as discussed by Hang, while Hang utilizes additional buffers after the quantizer and inside an intra/inter transform coefficients generator, thus increasing required buffer size in comparison with Boliek alone.

In view of the foregoing, Applicants respectfully submit that claim 1 should be allowable over Boliek and Hang.

Regarding claim 56, Applicants arguments set forth above with respect to claim 1 are applicable. In addition, Applicants note that Hang does not disclose any decoder embodiment. Further, the Hang encoder operation has nothing in common with decoder operation, and thus the complete buffer/quantizer controller 110 has no meaning at all.

In view of the foregoing, Applicants respectfully submit that claim 56 should be allowable over Boliek and Hang.

Regarding claims 3-13, 31-34, 40-41, 58-68, 86-89 and 95-96, these claims are dependent upon independent claims 1 and 56. If an independent claim is nonobvious under 35 USC § 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F. 2d 1071 (Fed. Cir. 1988). Thus, since independent claims 1 and

56 should be allowable as discussed above, claims 3-13, 31-34, 58-68, and 86-89, should also be allowable at least by virtue of their dependency on independent claims 1 and 56. Moreover, most of these claims recite additional features, which are not disclosed, or even suggested, by the cited references taken either alone or in a combination, according to the further arguments.

Regarding claims 113, 168, 225, and 280, while different in overall scope, these claims recite subject matter related to claims 1 and 56. Thus, the arguments set forth above with respect to claims 1 and 56 are equally applicable to claims 113, 168, 225, and 280. Accordingly, Applicants respectfully submit that claims 113, 168, 225, and 280 should be allowable over Boliek and Hang for the same reasons as set forth above with respect to claims 1 and 56.

Regarding claims 115-125, 143-146, 170-180, 198-201, 227-237, 255-258, 282-292, 310-313, 449, and 450 these claims are dependent upon independent claims 113, 168, 225, and 280. If an independent claim is nonobvious under 35 USC § 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F. 2d 1071 (Fed. Cir. 1988). Thus, since independent claims 113, 168, 225, and 280 should be allowable as discussed above, claims 115-125, 143-146, 170-180, 198-201, 227-237, 255-258, 282-292, 310-313, 449, and 450 should also be allowable at least by virtue of

their dependency on independent claims 113, 168, 225, and 280. Moreover, most of these claims recite additional features, which are not disclosed, or even suggested, by the cited references taken either alone or in combination.

In view of the foregoing, Applicants respectfully request that the aforementioned obviousness rejection of claims 1, 3-13, 31-34, 56, 58-68, 86-89, 113, 115-125, 143-146, 168, 170-180, 198-201, 225, 227-237, 255-258, 280, 282-292, 310-313, 449, and 450 be withdrawn.

VI. THE OBVIOUSNESS REJECTION OF CLAIMS 40, 41, 95, 96, 152, 153, 207, 208, 264, 265, 319, AND 320

On pages 18-20 of the Office Action, claims 40, 41, 95, 96, 152, 153, 207, 208, 264, 265, 319, and 320 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,141,446 to Boliek et al. ("Boliek") in view of U.S. Patent Hang No. 5,038,209 to Hang ("Hang") further in view of "Integer Multiplication and Division on the HP Precision Architecture", by Magenheimer et al. IEEE Transactions On Computers, Vol. 37, No. 8, August 1988 ("Magenheimer"). This rejection is hereby respectfully traversed with amendment.

Applicants respectfully submit that the aforementioned obviousness rejection of claims 40, 41, 95, 96, 152, 153, 207, 208, 264, 265, 319, and 320 has become moot in view of the

deficiencies of the primary references (i.e., Boliek and Hang) as discussed above with respect to independent claims 1, 56, 113, 168, 225, and 280. That is, claims 40, 41, 95, 96, 152, 153, 207, 208, 264, 265, 319, and 320 are dependent upon independent claims 1, 56, 113, 168, 225, and 280 and thus inherently incorporate all of the limitations of independent claims 1, 56, 113, 168, 225, and 280. Also, the secondary reference (i.e., Magenheimer) fails to disclose, or even suggest, the deficiencies of the primary references as discussed above with respect to independent claims 1, 56, 113, 168, 225, and 280. Indeed, the Examiner does not even assert such. Thus, the combination of the secondary reference with the primary references also fails to disclose, or even suggest, the deficiencies of the primary references as discussed above with respect to independent claims 1, 56, 113, 168, 225, and 280. Accordingly, claims 40, 41, 95, 96, 152, 153, 207, 208, 264, 265, 319, and 320 should be allowable over the combination of the secondary reference with the primary references at least by virtue of their dependency on independent claims 1, 56, 113, 168, 225, and 280. Moreover, claims 40, 41, 95, 96, 152, 153, 207, 208, 264, 265, 319, and 320 recites additional features which are not disclosed, or even suggested, by the cited references taken either alone or in combination.

In view of the foregoing, Applicants respectfully request that the aforementioned obviousness rejection of claims 40, 41, 95, 96, 152, 153, 207, 208, 264, 265, 319, and 320 be withdrawn.

VII. CONCLUSION

In view of the foregoing, Applicant respectfully submits that the present application is in condition for allowance, and an early indication of the same is courteously solicited. The Examiner is respectfully requested to contact the undersigned by telephone at the below listed telephone number, in order to expedite resolution of any issues and to expedite passage of the present application to issue, if any comments, questions, or suggestions arise in connection with the present application.

To the extent necessary, a petition for an extension of time under 37 CFR § 1.136 is hereby made.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 50-0206, and please credit any excess fees to the same deposit account.

Respectfully submitted,

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APPENDIX A